Advanced eye monitoring technologies: ready for operational platforms

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The ability to measure voluntary and automatic eye movements in operational environments provides opportunities for unobtrusive, real-time assessment of vigilance and physiological status, whether under the sea, on land, in aircraft or in space. This presentation outlines current and potential applications of small high speed digital camera sensors to monitor coordinated eye movements and pupil adjustments in real-time to provide reliable information on cognitive and neurologic performance. Heads-up displays with embedded high resolution eye monitoring technology allow assessment of eye tracking in three dimensions, particularly the 'near responses' for approaching and receding targets. Eye movement metrics in tasks with cognitive components are very promising for assessment of mild concussion and have provided compelling objective findings in personnel with unknown energy exposures in Havana. These technologies are being refined so that they can be embedded in undersea, surface and air operational platforms to both monitor warfighter physiological status and inform decision support interventions. Obvious application areas include real-time detection of performance decrements associated with evolving mild hypoxia, hypercarbia, hypothermia, vehicular noise/vibrations, directed energy exposures, and the functional monitoring of pilots using OBOGS. Because reflex eye movement timing parameters are modified predictably by concurrent tasks,[1] movement interval data can be developed as advanced gauges of contextual cognitive engagement in human-machine systems-of-systems.

[1] Balaban, CD, Furman JM. Beat-to-beat control of human optokinetic nystagmus slow phase durations. J Neurophysiol 117: 204–214, 2017. doi:10.1152/jn.00342.2016.